

EXERCISES FOR SECTION 2.3

In Exercises 1–6, use the Product Rule to differentiate the function.

1. $g(x) = (x^2 + 1)(x^2 - 2x)$
2. $f(x) = (6x + 5)(x^3 - 2)$
3. $h(t) = \sqrt[3]{t}(t^2 + 4)$
4. $g(s) = \sqrt{s}(4 - s^2)$
5. $f(x) = x^3 \cos x$
6. $g(x) = \sqrt{x} \sin x$

In Exercises 7–12, use the Quotient Rule to differentiate the function.

7. $f(x) = \frac{x}{x^2 + 1}$
8. $g(t) = \frac{t^2 + 2}{2t - 7}$
9. $h(x) = \frac{\sqrt[3]{x}}{x^3 + 1}$
10. $h(s) = \frac{s}{\sqrt{s} - 1}$
11. $g(x) = \frac{\sin x}{x^2}$
12. $f(t) = \frac{\cos t}{t^3}$

In Exercises 13–18, find $f'(x)$ and $f'(c)$.

Function	Value of c
13. $f(x) = (x^3 - 3x)(2x^2 + 3x + 5)$	$c = 0$
14. $f(x) = (x^2 - 2x + 1)(x^3 - 1)$	$c = 1$
15. $f(x) = \frac{x^2 - 4}{x - 3}$	$c = 1$
16. $f(x) = \frac{x + 1}{x - 1}$	$c = 2$
17. $f(x) = x \cos x$	$c = \frac{\pi}{4}$
18. $f(x) = \frac{\sin x}{x}$	$c = \frac{\pi}{6}$

In Exercises 19–24, complete the table without using the Quotient Rule (see Example 6).

Function	Rewrite	Differentiate	Simplify
19. $y = \frac{x^2 + 2x}{3}$			
20. $y = \frac{5x^2 - 3}{4}$			
21. $y = \frac{7}{3x^3}$			
22. $y = \frac{4}{5x^2}$			
23. $y = \frac{4x^{3/2}}{x}$			
24. $y = \frac{3x^2 - 5}{7}$			

In Exercises 25–38, find the derivative of the algebraic function.

25. $f(x) = \frac{3 - 2x - x^2}{x^2 - 1}$
26. $f(x) = \frac{x^3 + 3x + 2}{x^2 - 1}$

27. $f(x) = x\left(1 - \frac{4}{x+3}\right)$
28. $f(x) = x^4\left(1 - \frac{2}{x+1}\right)$
29. $f(x) = \frac{2x+5}{\sqrt{x}}$
30. $f(x) = \sqrt[3]{x}(\sqrt{x} + 3)$
31. $h(s) = (s^3 - 2)^2$
32. $h(x) = (x^2 - 1)^2$
33. $f(x) = \frac{2 - \frac{1}{x}}{x - 3}$
34. $g(x) = x^2\left(\frac{2}{x} - \frac{1}{x+1}\right)$
35. $f(x) = (3x^3 + 4x)(x - 5)(x + 1)$
36. $f(x) = (x^2 - x)(x^2 + 1)(x^2 + x + 1)$
37. $f(x) = \frac{x^2 + c^2}{x^2 - c^2}$, c is a constant
38. $f(x) = \frac{c^2 - x^2}{c^2 + x^2}$, c is a constant

In Exercises 39–54, find the derivative of the trigonometric function.

39. $f(t) = t^2 \sin t$
40. $f(\theta) = (\theta + 1) \cos \theta$
41. $f(t) = \frac{\cos t}{t}$
42. $f(x) = \frac{\sin x}{x}$
43. $f(x) = -x + \tan x$
44. $y = x + \cot x$
45. $g(t) = \sqrt[4]{t} + 8 \sec t$
46. $h(s) = \frac{1}{s} - 10 \csc s$
47. $y = \frac{3(1 - \sin x)}{2 \cos x}$
48. $y = \frac{\sec x}{x}$
49. $y = -\csc x - \sin x$
50. $y = x \sin x + \cos x$
51. $f(x) = x^2 \tan x$
52. $f(x) = \sin x \cos x$
53. $y = 2x \sin x + x^2 \cos x$
54. $h(\theta) = 5\theta \sec \theta + \theta \tan \theta$

In Exercises 55–58, use a computer algebra system to differentiate the function.

55. $g(x) = \left(\frac{x+1}{x+2}\right)(2x-5)$
56. $f(x) = \left(\frac{x^2 - x - 3}{x^2 + 1}\right)(x^2 + x + 1)$
57. $g(\theta) = \frac{\theta}{1 - \sin \theta}$
58. $f(\theta) = \frac{\sin \theta}{1 - \cos \theta}$

In Exercises 59–62, evaluate the derivative of the function at the indicated point. Use a graphing utility to verify your result.

Function	Point
59. $y = \frac{1 + \csc x}{1 - \csc x}$	$\left(\frac{\pi}{6}, -3\right)$
60. $f(x) = \tan x \cot x$	$(1, 1)$
61. $h(t) = \frac{\sec t}{t}$	$\left(\pi, -\frac{1}{\pi}\right)$
62. $f(x) = \sin x(\sin x + \cos x)$	$\left(\frac{\pi}{4}, 1\right)$